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DESCRIPTION OF THE IMMATURE STAGES AND THE ADULT MALE OF AN AUSTRALIAN MEALYBUG, MELANOCOCCUS ALBIZZIAE (MASKELL) (COCCOIDEA: PSEUDOCOCCIDAE)

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Abstract

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All instars of *Melanococcus albizziae* (Maskell) except for the adult female are described and illustrated. Characteristic features of each instar and of the species, including the incidence and form of the dorsal cerarii in nymphal instars, are discussed. The morphology of the adult male is examined in detail and compared with that of other species of the family.

Introduction

The taxonomy of Australian scale insects is generally poorly understood, in spite of the early interest of such workers as W.M. Maskell and the recognition that Australia is apparently the origin of many species of economic importance. However Williams' (1985) revision of the Australian Pseudococcidae based on the adult female stage has elucidated many of the historical problems of the family in this country. This treatment has provided a sound basis for an understanding of the group within Australia, but there is still an urgent need for more detailed descriptions and illustrations of the pre-adult instars and where possible the adult male.

The mealybug *Melanococcus albizziae* (Maskell) is found along the eastern coast of Australia, occurring predominantly on *Acacia* Willd. (Mimosaceae). It was thought to be restricted to this host-plant genus, there being doubt concerning earlier host-plant records on other genera (Williams, 1985). However the host-plant range of this mealybug must be reconsidered again as a breeding population of the species has recently been found on *Albizzia lophantha* (Willd.) in Victoria (Farrell, unpublished data). This is the first record of the mealybug on this host-plant since the species' original collection. *M. albizziae* is polyphagous on *Acacia* (Farrell, 1985; Williams, 1985), and is one of the few Australian mealybugs capable of inflicting damage on its native hosts (Williams, 1985). French (1916) reported death of the host-plant if an infestation was left unchecked. In Victoria the mealybug has been observed to attain locally high population levels, although only one individual host-plant has been observed to have died and it was not possible to attribute cause of death solely to the infestation (Farrell, 1985). However the level of damage attributable to sublethal, high density infestations is as yet unquantified.

While studying the ecology of this mealybug in southern Victoria, sufficient numbers of all instars of both sexes were collected to allow detailed description of the species. As Williams (1985) has provided details of the adult female, the descriptions presented here will be limited to the other stages of development.

Materials and methods

All material was collected in the Melbourne area (Farrell, 1985). Samples thought to contain males were returned to the laboratory to enable rearing of the adult males while all other material was used immediately to make slides or stored in 70% ethanol. Preparation of material for slide-mounting varied depending on the stage of the mealybug being examined. Small and delicate material such as early instars of both sexes and all pre-adult instars of the male were prepared using the techniques of Afifi and Kosztarab (1967), while later instars of the female were prepared using the techniques of Banks and Williams (1972). All stages were stained with acid fuschin and mounted in Euparal. Diagrams were produced using a camera lucida attached to a Zeiss compound microscope. Illustrations (except for adult male) include a central drawing of the insect with the left half representing the dorsal aspect and the right half the ventral aspect. Enlargements of important details are placed around the perimeter of the figure. These enlargements are not to the same scale in each illustration, nor are the dermal structures and enlargements in direct proportion to each other. Scale lines are for the central drawing only, the exception to this being the illustration of the adult male. Details of the adult male illustration are provided in the figure legend. All measurements of morphological characters are in micrometers and are given either as ranges or as means followed by ranges in parentheses. Were possible a minimum of ten replicates were used for each character. Terminology for females instars is based on Williams (1985) and for males instars on Afifi (1968). Voucher specimens of each stage described here and of the adult female, have been lodged in the Australian National Insect Collection, Canberra.

Melanococcus Williams

Melanococcus Williams, 1985: 203.

Type species. Dactylopius albizziae Maskell, 1892: 31.

Remarks. This genus was erected for 11 species of Australian mealybugs found on *Acacia*. Although close in character to two other genera, *Epicoccus* Cockerell and *Mutabilicoccus* Williams, the species of *Melanococcus* form a natural group if all characters are considered (Williams, 1985). In life the mealybugs are a dark reddish-brown to black with a flocculent ovisac beneath the body of the adult. The body itself is often shiny and usually without a covering (Williams, 1985). Important characteristics of the genus include the structure of the anal ring and anal lobes, the type of setae found on the derm, particularly the similarity between cerarian and dorsal setae, the presence of an anal bar and the presence of tubular ducts around the ventral margins. Also the cerarii are restricted to the last few abdominal segments, trilocular pores and ostioles are present and the circulus and multilocular pores are variable in their occurrence (Williams, 1985).

Melanococcus albizziae (Maskell)

Dactylopius albizziae Maskell, 1892: 31. — Lidgett, 1899: 54. — Froggatt, 1916: 814.

Dactylopius acaciae Maskell, 1892: 23. — Lidgett, 1899: 53. — Froggatt, 1916: 813.

Pseudococcus albizziae. — Fernald, 1903: 97.

Pseudococcus acaciae. — Fernald, 1903: 97.

Melanococcus albizziae. — Williams, 1985: 205.

First Instar (Fig. 1). Body ovoid, dorsoventrally flattened, naked and dark red in colour before leaving brood chamber; after settling becoming less dorsoventrally flattened, cigar shaped, covered with light dusting of waxy white powder. Legs and antennae large with respect to body. Slide-mounted specimens 473 (438–538) long, 248 (200–235) wide.

Dorsum: Cerarii arranged in a marginal series of 18 pairs. Anal lobe cerarii (Fig. 1A), of 2 conical setae, no auxiliary setae and a single trilocular pore within a lightly sclerotized area. Remaining cerarii (Fig. 1B), also made up of 2 conical setae and a trilocular pore, but setae indistinguishable from body setae and not associated with a sclerotized area. Dorsal body setae long and slender, few in number, arranged as follows: abdominal segments I to VII each medially with a pair of cerarian-like setae associated with a pair of trilocular pores, position of pores variable (Fig. 1C, D, E) and each side of segment with a submarginal seta associated with a trilocular pore except segments I, II where 2 pores per seta may occur; thorax: mesothorax and metathorax with transverse rows of setae apparently associated with each segment, the setae grouped medial and submarginal and each seta with a trilocular pore; prothorax and head variable, but usually 1 or both with a pair of medial setae with trilocular pores, prothorax occasionally with a submarginal seta and associated pore on each side. Pair of trilocular pores on abdominal segment VIII. Oral rim and oral collar ducts and multilocular pores absent. Anal ring (Fig. 1F) entire, with 6 setae. Abdominal ostioles present.

Venter: Anal lobe: anal bar with a long slender seta (Fig. 1G); apical setae robust, 84–102 long. Two pairs of long setae on abdomen segment IX ventral to anal ring. Ventral body setae (Fig. 1I), longer and more slender than dorsal body setae, anterior setae (Fig. 1J), longer than posterior setae; setae arranged as follows: on abdominal segments III to VII each side of body with a double row of submedial setae and a row of submarginal setae; submedial setae on segment VII with trilocular pore; submarginal setae with minute circular pore (Fig. 1H); abdominal segment II and III with a single row of submedial setae; mesothorax with a pair of setae and a trilocular pore between mid and hind legs and a pair of setae near labium; head with 6 to 8 setae between antennae. Microspines on all abdominal seg-

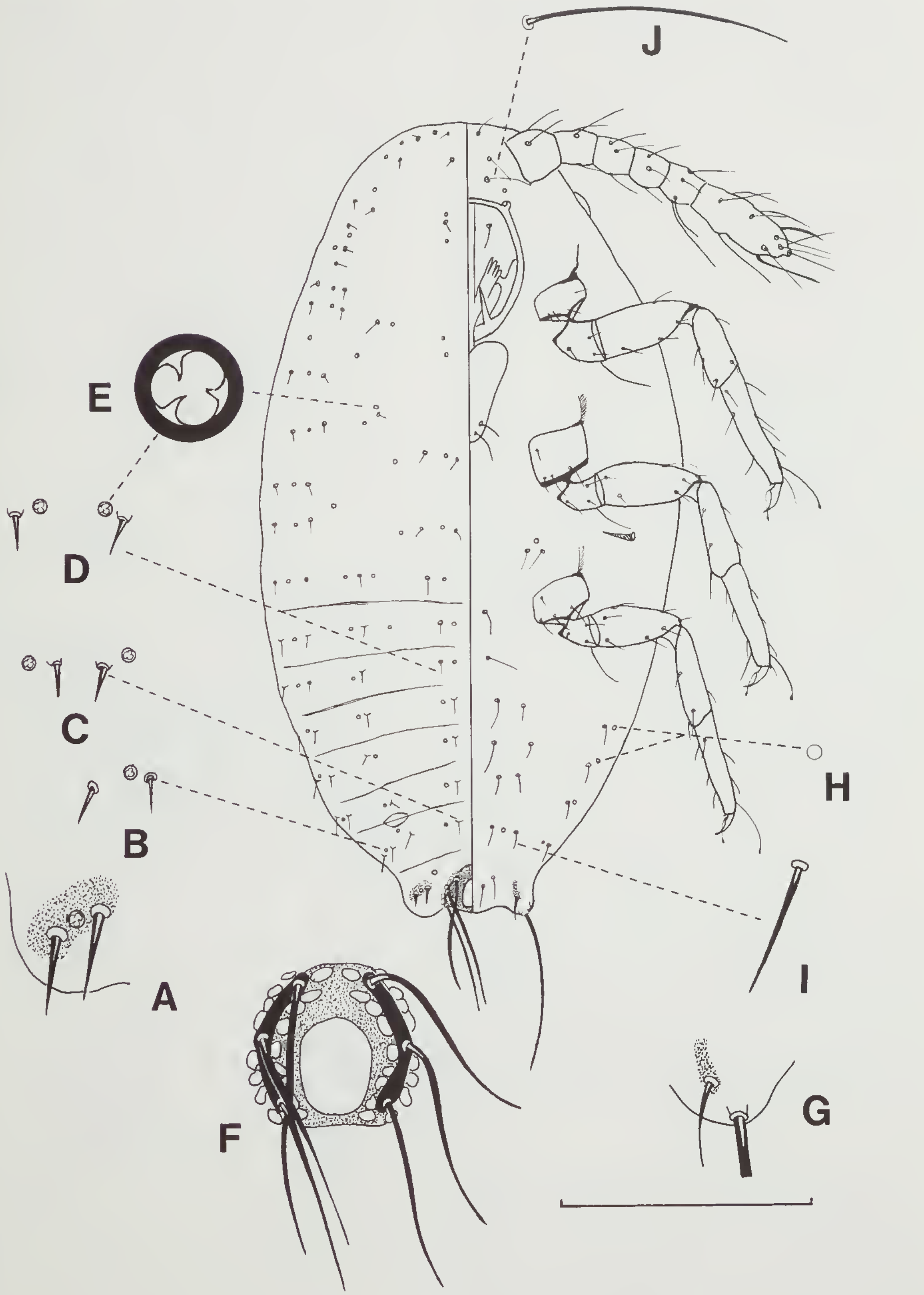

Figure 1. First instar *Melanococcus albizziae*. (See Appendix for abbreviations in this and all other figures. All scale lines 150 μm long.)

ments and most thoracic segments. Oral rim and oral collar ducts and multilocular pores absent. Circulus indistinct. Antennae with 6 segments, 170 (160–181, n = 14) long; terminal segment longest. Legs large compared to body and well developed; tarsal and claw digitules slender with knobbed apex. Length of hind femur: 58 (54–65 n = 19).

Second Instar (Fig. 2). Live specimens dark red to dark purple in colour, usually covered with a white waxy exudate. Cigar shaped, similar to settled first instar. Antennae and legs hidden under body. Slide-mounted specimens 819 (688–925) long, 468 (325–600) wide.

Dorsum: Cerarii restricted to abdominal segments. Anal lobe cerarii (Fig. 2A), formed of 2 conical setae, 1 auxiliary seta and 3–4 trilocular pores within a sclerotized area. Remaining cerarii (Fig. 2B), on segments IV to VII, occasionally segment III consisting of 2 conical spines more slender than anal lobe setae and a number of trilocular pores; cerarian setae becoming indistinguishable from body setae anteriorly. Dorsal body setae of 2 types: long spiny setae resembling cerarian setae (Fig. 2C), and shorter, more slender setae (Fig. 2D); arranged as follows: on abdominal segments I to VII in transverse rows and longitudinally into medial bands resembling dorsal cerarii, consisting of 3 setae and associated trilocular pores per segment, (Fig. 2C), setae becoming less closely grouped anteriorly; remaining setae on abdomen in band between medial setae and cerarii, consisting predominantly of cerarian-like setae with some smaller setae (Fig. 2D); on thorax in 2 transverse rows corresponding to position of mesothorax and metathorax with some setae scattered on remainder of thorax and head. Trilocular pores (Fig. 2E), present on head and thorax, associated with setae; abdominal segment VIII with a transverse row of 6 trilocular pores. Oral collar ducts occasionally present on abdomen submarginally. Oral rim and multilocular pores absent. Anal ring (Fig. 2F), entire, bearing 6 setae, 66–84 long. Cephalic and abdominal ostioles poorly defined; with setae and trilocular pores on outer lips.

Venter: Anal lobe (Fig. 2G) with anal bar bearing a long slender seta; apical setae 90–160 long, with a short seta and trilocular pore anterior to each apical seta. Two pairs of long setae on abdomen segment IX ventral to anal ring. Ventral body setae (Fig. 2H), longer and more slender than dorsal setae, anterior setae (Fig. 2I), longer than posterior setae; setae arranged on abdomen as follows: a double submedial row and a double submarginal row on segments III to VII; segment II and III with a pair of setae medially, submarginal setae variable; some abdominal segments occasionally with shorter setae distal to submarginal setae; body setae on thorax and head scattered randomly, but most numerous between antennae on head. Trilocular pores on abdomen near setae; on thorax near setae but also near spiracles and submarginally; on head randomly distributed. Microspines on all abdominal segments and most thoracic segments. Oral collar ducts (Fig. 2J) on abdomen submarginally, rarely on thorax. Oral rim pores absent. Circulus indistinct (Fig. 2K). Multilocular pores (Fig. 2L), associated with intercoxal setae on thorax. Antennae with 6 segments (Fig. 2M), 202 (178–218, n = 12) long; terminal segment longest. Legs well developed; tarsal and claw digitules slender with knobbed apex. Length of hind femur: 82 (69–90, n = 19).

Third Instar (*Female*) (Fig. 3). Live specimens dark red, covered with a white waxy exudate. Body elliptical, more rotund than previous stages. Antennae and legs hidden under body. Slide-mounted specimens 1250 (1017–1488) long, 820 (589–973) wide.

Dorsum: Cerarii restricted to abdominal segments. Anal lobe cerarii (Fig. 3A), formed of 2 conical setae, 2 or 3 setae similar to, but smaller than, cerarian setae, 2 or 3 auxiliary setae and a group of 6–9 trilocular pores; area lightly sclerotized, irregularly shaped. Remaining cerarii (Fig. 3B), on segments IV to VII, occasionally segment III, consisting of 2 conical spines more slender than anal lobe setae and a number of trilocular pores: cerarian setae becoming indistinguishable from body setae anteriorly. Body setae of 2 types: longer setae, resembling cerarian setae (Fig. 3C), and indistinguishable from anterior cerarian setae and shorter, more slender setae; longer setae arranged as follows: in transverse rows on abdominal segments I to VII, each segment having a medial group of 3 setae and associated trilocular pores resembling dorsal cerarii (Fig. 3C), medial setae becoming more slender and less closely grouped anteriorly; thorax and head predominantly with cerarian-like setae scattered in clumps. Shorter body setae scattered over body. Trilocular pores (Fig. 3D), in transverse rows on abdomen; scattered over thorax and head, but tending to be near setae. Minute circular pores (Fig. 3E), scattered on thorax. Oral collar and oral rim ducts and multilocular pores absent. Anal ring (Fig. 3F), entire, bearing 6 setae, 78–102 long. Cephalic ostioles faint and abdominal ostioles poorly defined, but

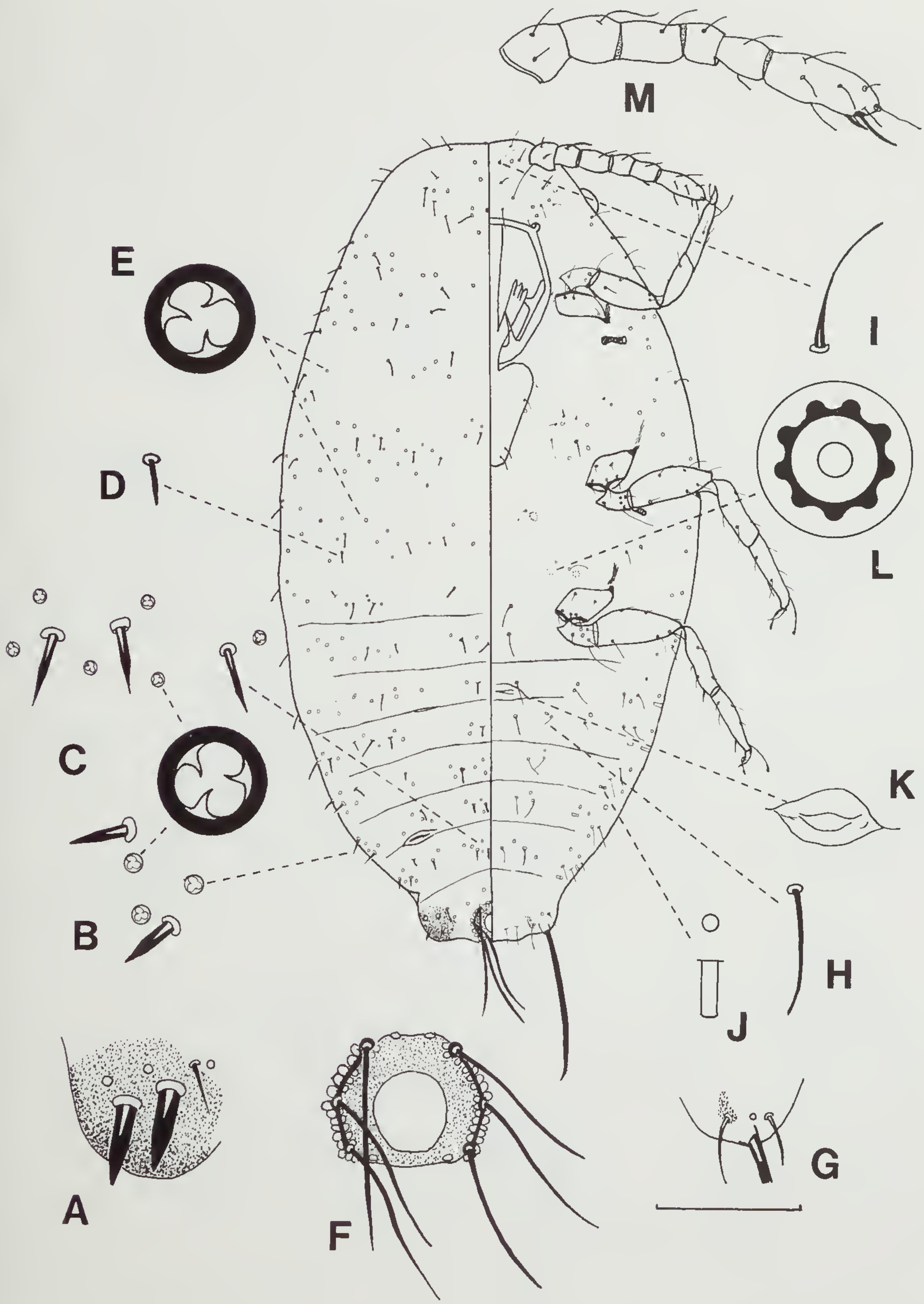

Figure 2. Second instar *Melanococcus albizziae*.

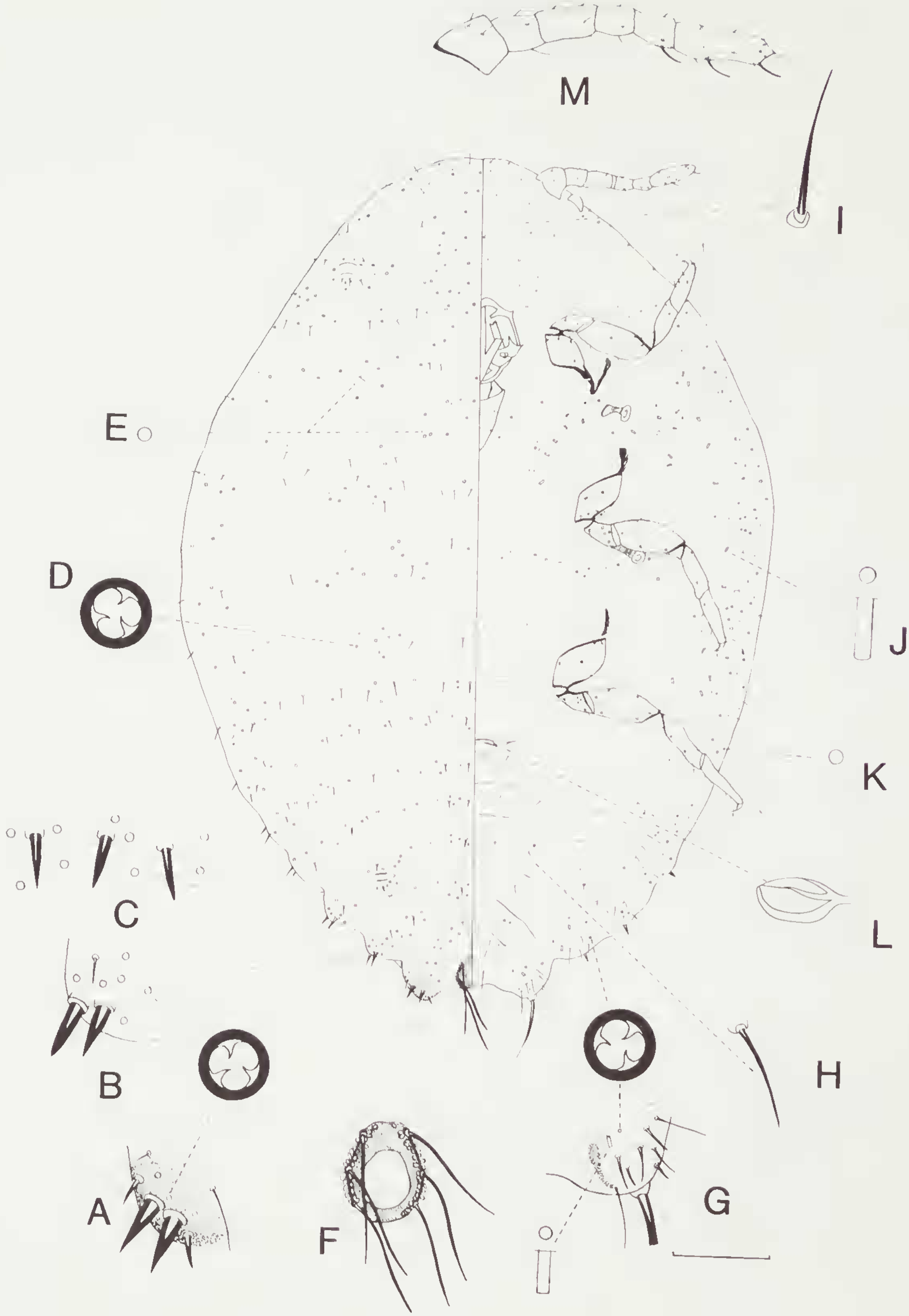

Figure 3. Third instar female *Melanococcus albizziae*.

more distinct; both with setae and trilocular pores on outer lips.

Venter: Anal lobe (Fig. 3G), with anal bar bearing a long slender seta; apical setae robust 132–156 long; 3 to 4 trilocular pores, several oral collar ducts and 4 to 6 auxiliary setae also on anal lobe. Three pairs of long setae on abdomen segment IX ventral to anal ring. Ventral body setae (Fig. 3H), longer and more slender than dorsal setae, anterior setae (Fig. 3I), longer than posterior setae; setae on abdomen in transverse rows; on thorax, submarginally and between legs; on head between antennae. Trilocular pores numerous submarginally on abdomen and thorax, around spiracles and associated with body setae between coxae; less numerous medially on abdomen and head. Microspines absent. Oral collar ducts (Fig. 3J) scattered submarginally on abdomen, submarginally and medially on thorax. Oral rim ducts absent. Minute circular pores (Fig. 3K), scattered over venter, usually associated with setae. Circulus indistinct (Fig. 3L). Multilocular pores rarely present. Antennae with 6 segments (Fig. 3M), 235 (223–258, n = 11) long, terminal segment longest. Legs well developed; tarsal and claw digitules slender with knobbed apex. Length of hind femur: 89 (81–102, n = 18).

Third Instar (*Male*) (Fig. 4) In life red in colour, body elongate, wing pads small; often covered by fluffy white wax test. Slide-mounted specimens 1068 (992–1116) long, 512 (485–576) wide.

Dorsum: Lateral margin of abdominal segments IV to VII, and occasionally segments II and III, each with 2–3 marginal setae grouped together and often near oral rim ducts. (Fig. 4A). Segment VIII with 3 setae (Fig. 4B), in a transverse row on lateral margin. Marginal setae occasionally occuring on thorax. Body setae similar to marginal setae, as follows: in transverse rows on abdominal segments II to VII, each segment having a medial group of 3 setae (Fig. 4C); on thorax (Fig. 4D), setae scattered on metathorax and prothorax, absent or rare on mesothorax; on head concentrated anteromedially. Trilocular pores absent. Multilocular pores (Fig. 4E) in irregular transverse rows on abdomen, scattered over thorax and head, but mainly associated with setae. Oral rim ducts (Fig. 4F), common on abdomen, but less frequent on thorax and head. Oral collar ducts absent. Hamulohalteres not apparent. Wing buds 119 (84–150) long, 115 (102–120) wide. Abdominal ostioles present. Genital segment: penial sheath with microspines; anal opening dorsal; apically 2 pairs of setae. Sheath 63 (54–78) long, 97 (84–108) wide.

Venter: Segment VIII (Fig. 4G), with apical setae 69–102 long and 2 shorter auxiliary setae. Ventral body setae (Fig. 4H), shorter than dorsal body setae; in transverse rows on abdomen, scattered over thorax; setae on head between antennae, longer. Multilocular pores (Fig. 4I), in transverse rows on abdomen, generally scattered on thorax but concentrated around spiracles, rare on head. Oral rim ducts (Fig. 4J), scattered on abdomen marginally; on thorax usually near spiracles and marginally on mesothorax. Oral collar ducts absent. Antennal segments often partly fused, segmentation variable; total length 233 (216–294). Legs developed, with short setae; tibiotarsal articulation absent. Length of hind femur: 108 (99–118, n = 11).

Fourth Instar (*Male*) (Fig. 5). In life red in colour, body elongate, wing pads well developed; antennae long; body often covered by fluffy text of white waxy threads. Slide-mounted specimens 1142 (992–1240) long, 434 (359–484) wide.

Dorsum: Lateral margin of each abdominal segment II to VII with 2-3 setae (Fig. 5A), in cluster resembling cerarii; with associated oral rim ducts. Abdominal segment VIII with a submarginal transverse row of 3 setae (Fig. 5B), similar to other submarginal abdominal setae, but not associated with oral rim ducts. Body setae similar to marginal setae, arranged as follows: in transverse rows on abdominal segments II to VII, each segment with medial group of 3 setae similar to dorsal cerarii (Fig. 5C); on thorax in a single row and clustered at base of wing bud of mesothorax, in transverse row and submarginally on prothorax; scattered over head. Trilocular pores absent. Multilocular pores (Fig. 5D) in transverse rows on abdominal segments III to VII; on thorax, near metathoracic body setae (Fig. 5E). Oral rim ducts (Fig. 5F), near abdominal cerarian-like submarginal setae; on prothorax submarginally. Oral collar ducts absent. Postocular ridge present; dorsal portion of ocular sclerite weakly sclerotized. Hamulohalteres not apparent. Wing buds 404 (311–516) long, 114 (68–141) wide. Abdominal ostioles present. Genital segment: penial sheath with microspines; anal opening dorsal; 2 pairs of setae apically. Sheath 74 (69–84) long, 101 (90–108) wide.

Venter: Segment VIII (Fig. 5G), with apical setae 75–102 long and 2 shorter auxiliary setae. Ventral body setae (Fig. 5H), shorter than dorsal

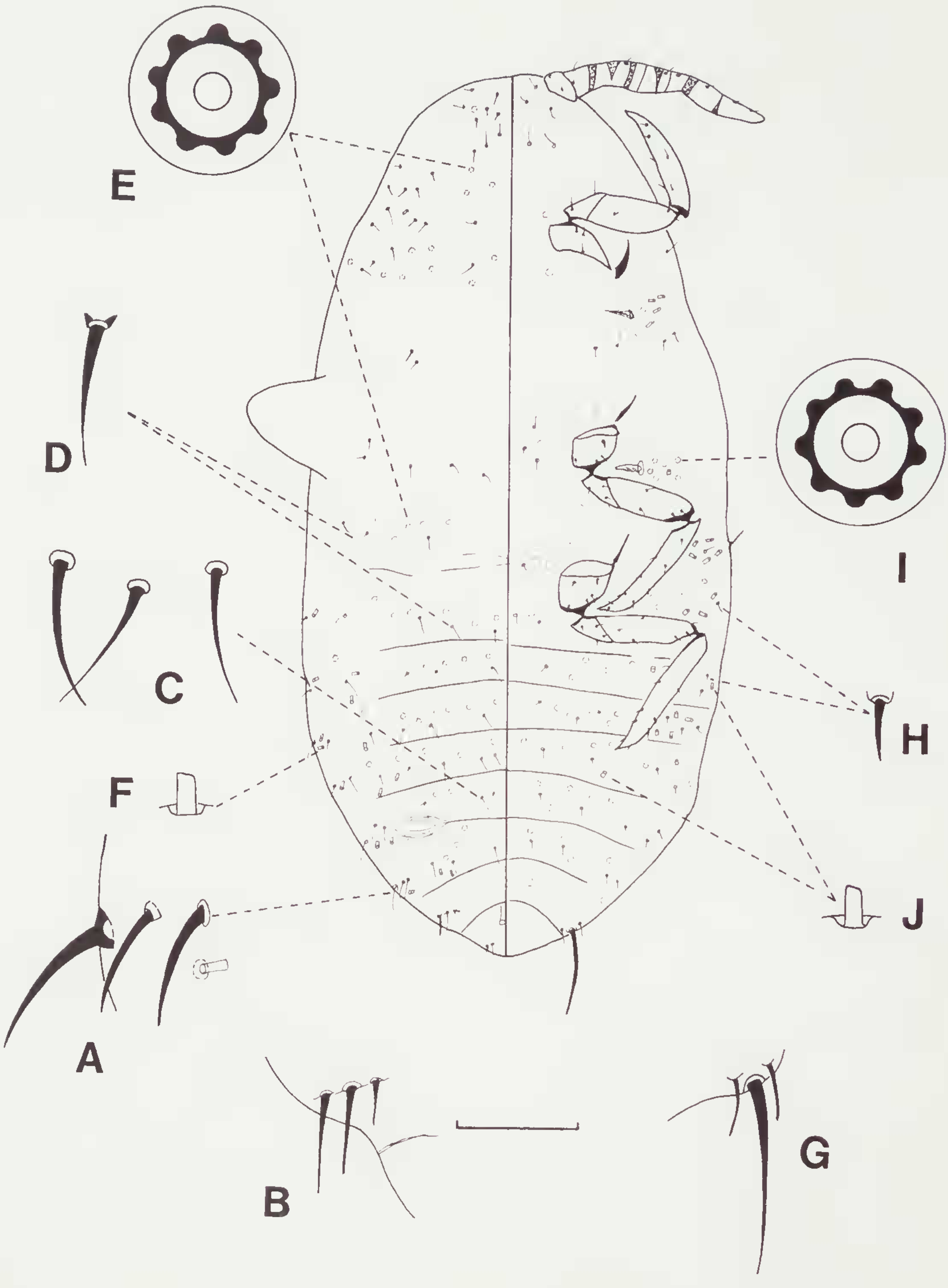

Figure 4. Third instar male *Melanococcus albizziae*.

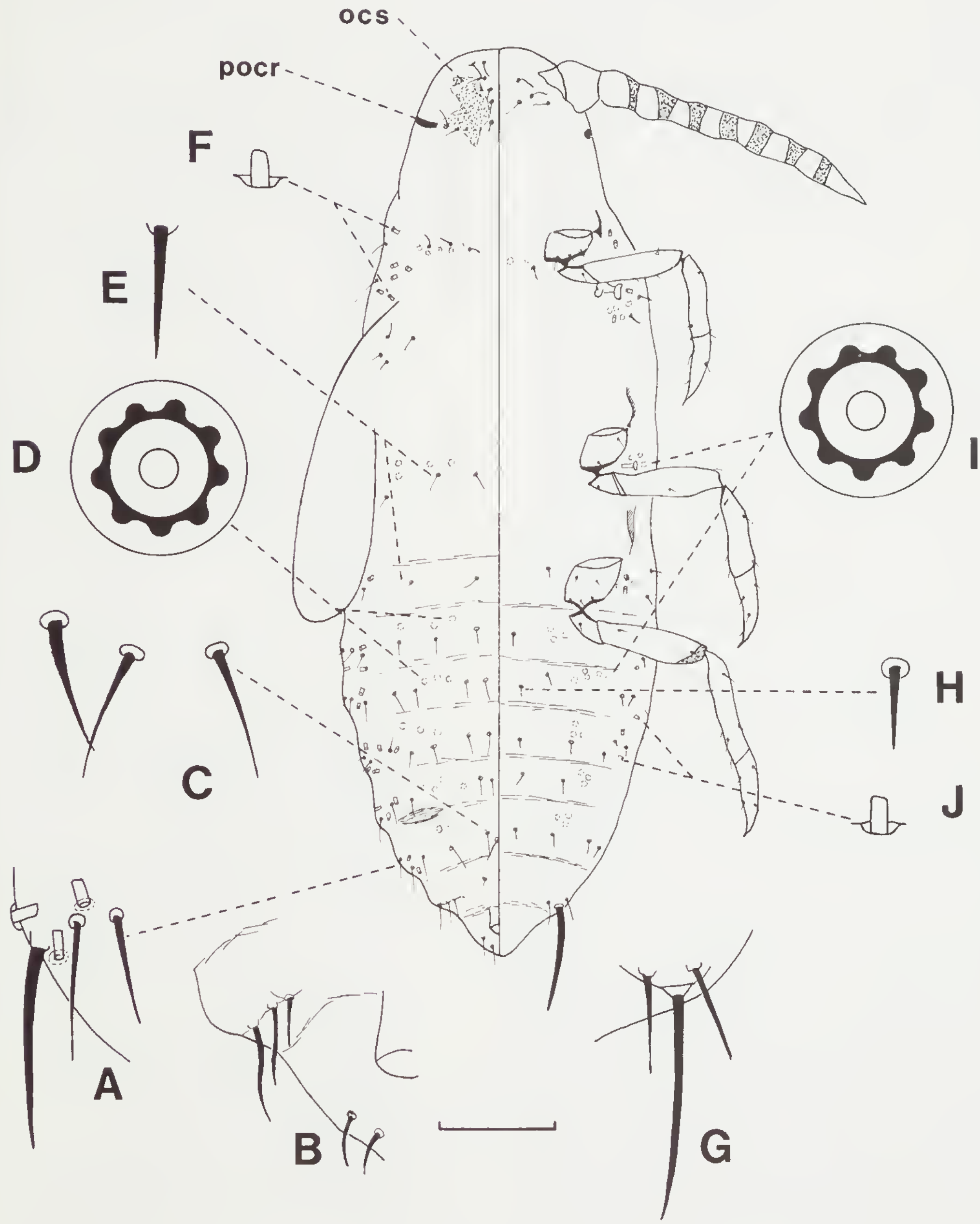

Figure 5. Fourth instar male *Melanococcus albizziae*.

body setae; in transverse rows on abdomen; densest around spiracles on thorax with occasional seta associated with coxa; setae longer on head, between antennae. Multilocular pores (Fig. 5I), in clusters on abdominal segments II to VIII; on thorax near spiracles and between fore coxa. Oral rim ducts (Fig. 5J), on lateral margins of abdominal segments II to VII; rare on thorax and head. Oral collar ducts absent. Antennal segments well developed, 9 segmented, 411 (375–447, n = 7) long; apical segment longest. Legs well developed; with tibiotarsal articulation and setae. Length of hind femur: 136 (123–141, n = 9).

Fifth Instar (*Adult Male*) (Fig. 6) In life red in colour, body slender, narrow; wings, antennae moderately sized compared with body. Slide-mounted specimens 1080 (1030–1184) long, 278 (225–338) wide; wing span 2338 (1183–1426).

Head: Subtetrahedral; subtriangular in dorsal and anterior view (Fig. 6A,C); ventral preocular depression not apparent in lateral view (Fig. 6B). Length 177 (125–192), width 206 (190–225). Dorsal arms of midcranial ridge anteriorly detached from other arms (Fig. 6C), posteriorly meeting postocular ridge; ventral and lateral arms forming Y-shaped ridge, ventral ridge poorly defined, reduced to slender line surrounded by irregular sclerotized area (Fig. 6C). Postocular ridge U-shaped, discontinuous with preocular ridge anteriorly; thickest posteriorly, tapering anteriorly and terminating at preocular ridge; posterior edge of ridge lightly sclerotized. Preocular ridge and interocular ridge joined posteriorly to postocular ridge below ocellus. Preoral ridge slender. Eyes: dorsal simple eyes with corneae 25.8 (22.5–35.0) in diameter, ventral simple eyes with corneae 25.3 (22.5–32.5) in diameter. Lateral ocelli large. Cranial apophysis truncated apically. Tentorial bridge very slender. Dorsal setae: 8–13 on each side of midline. Genial setae: 2–3 on each side of midline. Ventral head setae: 3–8 between ventral simple eyes; 19–22 in a transverse band across area of ventral preocular depression; 5–7 associated with lateral arms of midcranial ridge. Head disc pores (Fig. 6E): 1 pore associated with base of antennae.

Antennae: Filiform, 10-segmented, 683 (633–718) long; longer than half body ratio (ratio 1:1.30–1.71, average 1.58) and slightly longer than hind leg (ratio 1 : 1.08–1.23, average 1.17). Size of segments given in Table 1. Scape with 4 hair-like setae. Pedicel and flagellum with

Table 1. Length and width of antennal segments of adult male *Melanococcus albizziae.*

	Segment (µm)									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Length										
range	37.2–48.0	54.0–69.0	69.0–93.0	69.0–88.8	63.0–87.6	66.0–90.0	60.0–78.0	61.8–72.0	48.0–66.0	60.0–78.0
mean	41.0	61.7	79.9	78.0	74.9	76.7	68.6	67.1	57.3	67.2
n	8	8	8	8	8	8	6	6	8	8
Width										
range	39.0–48.0	33.0–42.0	27.0–30.6	23.4–28.8	24.0–28.2	24.0–27.0	22.8–27.0	21.0–24.0	19.8–24.0	18.0–24.0
mean	44.1	38.5	27.8	25.8	25.7	25.0	24.8	23.5	22.6	20.4
n	8	8	8	8	8	8	6	6	8	8

Figure 6. Fifth instar male (adult) *Melanococcus albizziae*. A, dorsal and ventral aspeets of body. B, lateral aspeet of body. C, head, anterior view. D, 10th antennal segment, dorsal view. E, body pores. F, minute eireular pores.

numerous fleshy setae. Apical segment (Fig. 6D), with 2 subapical sensory setae; 2 antennal bristles subapically; 1 apical hair-like seta. Pedicel with sensillum placodeum dorsally. Hair-like setae variable, at most 1-2 per segment.

Thorax. Prothorax: Pronotal ridge usually with medial interruption; lateral pronotal sclerites and post-tergites distinct. Proepisternum bound ventrally by ridge-like structure reaching pleural ridge. Remaining pleural structures normal for family. Prosternum subtriangular, bounded posteriorly by well developed prosternal ridge. Prothoracic setae on each side: 1–2 medial pronotal setae; post-tergal setae absent; lateral pronotal setae absent; 0–4 antespiracular dorsal setae; antespiracular ventral setae absent. 0–2 prosternal setae, occasionally with 1 seta on apex of sclerite. Prothoracic pore on each side: 0–1 medial pronotal pores; 0–1 lateral pronotal pores; 2–3 antespiracular dorsal pores; 0–1 prosternal pores.

Mesothorax: Prescutum 82 (65–95) long, 133 (122–150) wide. Prescutal ridge well developed, prescutal suture developed but indistinct medially. Scutum 115 (100–125) long, 207 (180–240) wide; with heavily anterolateral, posterolateral sclerotization, medial area with narrow longitudinal membranous band. Prealare and triangular plate well developed, prealar ridge distinct. Scutellum 66 (50–85) long, 122 (100–160) wide; scutoscutellar suture and inward fold of posterior margin of notum well developed; medial ridge variable, but often distinct longitudinally, dividing sclerite. Postalare with well separated anterior and posterior postalar ridges. Mesopleuron: mesopleural ridge interrupted above coxal articulation; basalare present. Other pleural structures typical for family. Mesosternum: basisternum 148 (122–170) long, 233 (180–268) wide. Marginal and precoxal ridges strong; furca well developed. Thoracic setae on each side: 2–5 prescutal setae; 3–7 scutal setae; 2–5 scutellar setae; 4–8 postmesostigmatal setae; 0–4 tegular setae. Basisternal setae: 11–33 over entire sclerite. Pores on each side: 1 postmesostigmatal pore; 2–3 mesospiracular pores.

Metathorax: Metapostnotal sclerites and metapostnotal ridge well developed. Pleural ridge with pleural apophysis. Episternum and epimeron distinct, precoxal ridge well developed, tending to anteriorly delineate episternum. Metasternal apophysis distinct but occasionally absent. Metathoracic setae on each side: 1–3 metatergal setae; 0–2 metapleural setae; 1–4 anterior metasternal setae; 1–2 posterior metasternal setae. Pores on each side: metatergal pores absent; 1–2 metaspiracular pores; 1 anterior metasternal pore; 0–1 posterior metasternal pores.

Wings: 1031 (928–1088) long, 417 (371–454) wide. Alar lobe: additional sclerites developed: first and second auxiliary sclerites well developed, third auxiliary sclerite difficult to detect. Usually 3 alar setae, 2 circular sensoria. Hamulohalteres present; with 1 apical seta.

Legs: Of moderate length and slender (Table 2). All segments with numerous hair-like setae. Tarsus with 2 tarsal digitules, ungual digitules on claw absent. Trochanter with 2–3 circular sensilla on each side and 1 long apical seta. Tibia with 2 apical spurs and 2 smaller spine-like hairs.

Abdomen: 557 (487–650) long, 277 (225–377) wide. Tergites: present as 2 small submedial plates on segment I; absent on segments II to VII; represented by a transverse band on segment VIII. Sternites absent except for a weakly sclerotized area on either side of segment VIII. Ostioles greatly reduced. Abdominal setae: dorsal setae on each side in transverse rows on each segment and longitudinally as a medial and submedial band; medial setae as follows: segment VIII always with 2 setae on posterior edge of tergites; segment VII, 2–3 setae; segment VI, 3–4 setae; segments I to V, 2 setae; and submedial setae: in double row on segments I to VII, absent segment VIII. Segment II occasionally with a single seta between medial and submedial setae. Pleural setae in transverse rows on each side: segments I and II, 2–3 setae; segments II to VII 4–6 setae. Ventral setae on each side in transverse rows and longitudinally in medial and submedial bands; medial setae arranged as follows: segments II to VII, 2 setae; submedial setae as follows; segments II to VII, 1 seta. Segment III usually with a single seta between medial and submedial setae. Abdominal pores: pleural pores: 0–3 minute circular pores (Fig. 6F), on segments I to VII; ventral pores: 0–1 disc pores near submedial setae; 0–1 circular pores on segments III to VIII near medial, and occasionally, submedial setae.

Glandular pouch well developed, with a pair of long tail setae and 2 long hair-like setae.

Genital segment: small, triangular dorsally; style curved upwards in lateral view. Penial sheath 112 (90–125) long, 80 (76–88) wide. Basal ridge well developed, its projection and process of penial sheath distinct. Aedeagus tapering posteriorly to a point. Setae of genital segment on each side: dorsally, 3 near style; ven-

Table 2. Length and width of leg segments of adult male *Melanococcus albizziae*.

	Segment (µm)				
	Coxa	Trochanter	Femur	Tibia	Tarsus
Leg I					
Length					
range	30–62	50–62	137–172	155–205	75–87
mean	46	58	152	167	83
n	10	11	8	12	12
Width					
range	47–62	25–37	32–40	17–25	15–20
mean	55	29	36	21	19
n	10	11	8	12	12
Leg II					
Length					
range	37–50	25–57	125–155	147–200	75–100
mean	44	55	147	186	84
n	8	8	10	12	14
Width					
range	45–55	22–27	32–40	17–22	15–20
mean	49	26	35	18	19
n	8	8	10	12	14
Leg III					
Length					
range	37–62	55–62	137–187	175–250	75–100
mean	49	60	150	217	87
n	10	9	12	14	14
Width					
range	47–55	25–30	32–42	17–22	15–22
mean	52	25	36	19	17
n	10	9	12	14	14

trally 3–4 setae on the penial sheath: 2–3 setal sensilla on process.

Remarks. This species was simultaneously described under two different names in the same paper (Maskell, 1892), highlighting the historical difficulties modern workers have faced with the Australian mealybugs. Although Fernald (1902) transferred the species to *Pseudococcus* Westwood, Froggatt (1916) later returned it to *Dactylopius* O. Costa. The genus *Dactylopius* is now the sole member of the Dactylopiidae (De Lotto, 1974), the family being characterized by its host specificity to the cactaceous plants, particularly those of the genus *Opuntia. Dactylopius albizziae* is thereby excluded from this genus and a new genus, *Melanococcus*, was erected to accomodate it (Williams, 1985).

M. albizziae can be distinguished from other members of the genus by the conical dorsal setae being about the same size as those on the anal lobe (Williams, 1985).

Key to instars of *Melanococcus albizziae* (Maskell)

Although it was possible to seperate instars on the length of the hind femur, other morphological characters were also diagnostic. These characters have been used to construct the key presented here. Although not described here the adult female has been included for completeness. As the adult male is easily distinguished from other instars, it has not been included.

1. Wing buds present 5
— Wing buds absent 2

2. Derm without tubular ducts and multiocular pores; each dorsal cerarius with only 2 setae .... 1st instar
— Derm without either tubular ducts or multiocular pores; dorsal cerarii with 3 setae 3
3. At least marginal cerarii of abdominal segment VIII with more than 2 setae; multilocular pores on abdomen in region of vulva Adult female
— Marginal cerarii with a maximum of 2 setae; multilocular pores either absent or if present, on thorax only 4
4. Multilocular pores absent; minute circular pores on dorsum; anal lobe with 3–4 trilocular pores, several oral collar ducts and 4–6 auxilary setae .... 3rd instar female
— Multilocular pores present, but restricted to area anteromedial to hind coxa; minute circular pores absent; anal lobe with 1 auxilary seta and 1 trilocular pore .... 2nd instar female
5. Wing pads as long as wide; antennal segments partly fused, segmentation variable; legs without tibiotarsal articulation .... 3rd instar male
— Wing pads longer than wide; antennae with 9 well defined segments; legs with tibiotarsal articulation .... 4th instar male

Discussion

The presence of marginal cerarii is a characteristic of the Pseudococcidae, but dorsal or medial cerarii are less common (Ferris, 1950; McKenzie, 1967). The presence of dorsal cerarii on *M. albizziae* is thus noteworthy. These structures are characterised in first instars by two conical setae and a pair of associated pores (Fig. 1C), and in subsequent instars by three setae and associated pores (Fig. 2C, 3C). The setae of each dorsal cerarius are equal or subequal in size and shape to the setae of the corresponding marginal cerarius. The dorsal cerarii are located medially on each abdominal segment and like the marginal cerarii, are most distinct on abdominal segment VII, but become less obvious anteriorly. The actual number of distinguishable cerarii, both marginal and dorsal, varied from instar to instar and individual to individual, with the largest recognizable number being found on the first instar and the smallest number on the adult female. On all individuals examined, no dorsal cerarii were found anterior to the abdomen. In male instars the abdominal segments also bore dorsal setae arranged into groups of three along the midline. However unlike the females, there were no pores associated with these setae (Fig. 4C, 5C, 6A). Pre-adult male instars also had marginal cerarii, but these were associated with tubular ducts rather than trilocular pores as in female instars. It is of interest to note that while it is often difficult to differentiate types of tubular ducts in female instars of Australian mealybugs (Williams, 1985), no such difficulties were observed in the males of *M. albizziae*.

The trilocular pores of the dorsal cerarii of the first instar exhibited an interesting orientation in relationship to the setae. In all material examined the cerarii of abdominal segments IV to VII had a pair of setae between a pair of pores (Fig. 1C), while the cerarii of segments I to III had the pair of pores between the pair of setae (Fig. 1D). It is not known why this change in orientation occurred, but it was a constant pattern in all individuals.

The classification of the Pseudococcidae, as with all other families of Coccoidea, is still firmly based on female morphology (Williams, 1985), although other instars, including the adult males, provide characters of phylogenetic value (Afifi, 1968; Boratynski, 1970; Williams, 1985). Specifically males are thought to better represent ancestral affinities, particularly at higher levels of classification (Boratynski, 1970), although they can also be useful at an intrafamilial level (Boratynski and Davies, 1971; Davies and Boratynski, 1979; Davies, 1981). Although descriptions of adult males are not available for the two genera indicated by female morphology to be most closely related to *Melanococcus*, it was possible to compare the adult male of *M. albizziae* with the twenty species of mealybugs described by Afifi (1968).

Based on these data sets Afifi (1968) used 134 characters to separate the species into four groups of genera. Using the same character states, *M. albizziae* shows greatest affinity (85–101 shared character states) with the *Planococcus*-group. Within the *Planococcus*-group most features were shared with two *Nipaecoccus* Sulc species, *N. vastor* (Maskell) (101) and *N. nipae* (98). However *M. albizziae* also exhibited character states considered exclusive to other groups of genera. These are: (i) the lack of a ventral preocular depression (*Saccharicoccus*-group), (ii) a ridge-like ventral margin to the proepisternum (Ceroputo group), and (iii) the absence of a trochantin (*Nairobia*-group). While the first and last of these features can be explained by convergence, the ridge-like ventral margin to the proepisternum, thought by Afifi (1968) to be a specialization, can not. The *Planococcus*-group exhibited the generalized condition of most character states and as a whole was considered by Afifi (1968) to be the most ancestral of the four groups. It would seem that based on male morphology *M. albizziae* is closely allied to the *Planococcus*-group and *Nipaecoccus* in particular. However within the limitations of Afifi's analysis, the presence of the ridge-like ventral margin to the proepisternum in *M. albizziae* alone is sufficient to exclude the species from the grouping.

Female scale insects are neotenic, highly specialized plant parasites that display a high degree of convergence and so provide few characters on which to base evolutionary relationships. The morphologically more conservative males retain primitive characters lost in the female and provide potential clues to relationships. However the Australian phytophagous fauna has been characterised by rapid evolution and specialization paralleling the rapid evolution of the autochthonous element of the Australian flora (Barlow, 1981; New, 1983). This provides an ideal situation for diffuse coevolution (Fox, 1981) and it has been postulated that this leads to the evolution of taxonomically difficult groups (New, 1983). Australian mealybugs are thought to be of Gondwanan origin (Williams, 1985), with most species found on host-plant genera with (evolutionary) recent and extensive radiations (Gill, 1975; Williams, 1985). Is not surprising, then, that *M. albizziae* failed to fit into the Afifi's (1968) framework, given that it was based on cosmopolitan and non-Australian species.

It is possible that the study of the taxonomy of male scale insects may play an important role in illuminating the systematic of the Pseudococcidae and other families of the Australian fauna. For example Williams (1985) has suggested that the true relationships of the Australian species of *Pseudococcus* may only be understood when the males are studied.

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Appendix

Abbreviations used in figures.

ab, antennal bristles. ads, abdominal dorsal setae. aed, aedeagus. al, alar lobe. als, alar setae. amsp, anterior metasternal pores. amss, anterior metasternal setae. anp, anterior notal wing process. apar, anterior postalar ridge. app, abdominal pleural pores. aps, abdominal pleural setae. as, abdominal sternite. asdp, antespiracular dorsal pores. at, abdominal tergites. avp, abdominal ventral pores. avs, abdominal ventral setae. bas, basalare. bra, basal rod of aedeagus. brps, basal ridge of penial sheath. ca, cranial apophysis. cl, claw. cx, coxa. dhp, dorsal head pores. dhs, dorsal head setae. dmcr, dorsal arm of midcranial ridge. dse, dorsal simple eyes. epm2, mesepimeron. epm3, metepimeron. eps2, mesepisternum. eps3, metepisternum. f, furca. FIII-X, flagellum segments – 3rd to 10th. fm, femur. fs, fleshy setae. g, gena. gls, setae of glandular pouch. gp, glandular pouch. gs, genal setae. gts, setae of genital segment. h, hamulohaltere. lmcr, lateral arm of midcranial ridge. lpp, lateral pronotal pores. mcd, marginal ridge. mpnp, medial pronotal pores. mpns, medial pronotal setae. mps, metapleural setae. mr, marginal ridge. mts, metatergal setae. o, ocellus. ocs, ocular sclerite. ost, ostiole. pa, postalare. pcr2, precoxal ridge of mesothorax. pcr3, precoxal ridge of metathorax. pdc, pedicel. pepcv, proepisternum + cervical sclerite. plr2, mesopleural ridge. plr3, metapleural ridge. pmp, postmesostigmatal pores. pms, postmesostigmatal setae. pn3, metapostnotum. pna, postnotal apophysis. pn3r, metpostnotal ridge. pocr, postocular ridge. por, postocular ridge. ppar, posterior postalar ridge. pra, prealare. prar, prealar ridge. prn, lateral pronotal sclerite. prnr, pronotal ridge. pro, process of penial sheath. procr, preocular ridge. pror, preoral ridge. pros, setal sensilla of process of penial sheath. prsc, prescutum. pscr, prescutal ridge. pscse, prescutal setae. pt, post tergite. pwp, mesopleural wing process. rad, radius. scl, scutellum. scp, scape. sct, scutum. sctse, scutal setae. sens, circular sensoria. ser, subepisternal ridge. set scla, subapical sensory setae. sp2, mesothoracic spiracle. sp3, metathoracic spiracle. sp2p, mesospiracular pores. sp3p, metaspiracular pores. st, style. stn1, prosternum. stn2, mesosternum (basisternum). stn1r, prosternal ridge. stn1s, prosternal setae. stn2s, basisternal setae. tar, tarsus. tdgt, tarsal digitules. vhs, ventral head setae. vmcr, ventral arm of midcranial ridge. vse, ventral simple eyes.